Lecture Module - Calibration

ME3023 - Measurements in Mechanical Systems

Mechanical Engineering

Tennessee Technological University

Topic 3 - Linear Regression

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- Motivation - Functional Relationship
- Least Squares Regression
- Using Software Packages
- Example: IR Sensor Calibration

Motivation - Functional Relationship

A measured variable is often a function of one or more independent variables that are controlled during the measurement. ... This is a common procedure used to document the relationship between the measured variable and an independent process variable. ...

We can use _____ analysis to establish a _____between the _____and the _____. This discussion pertains directly to _____curve fits.

Other functions such as _____and _____fits can also be used.

Least Squares Regression

Consider the graphs below. This is a calibration curve.

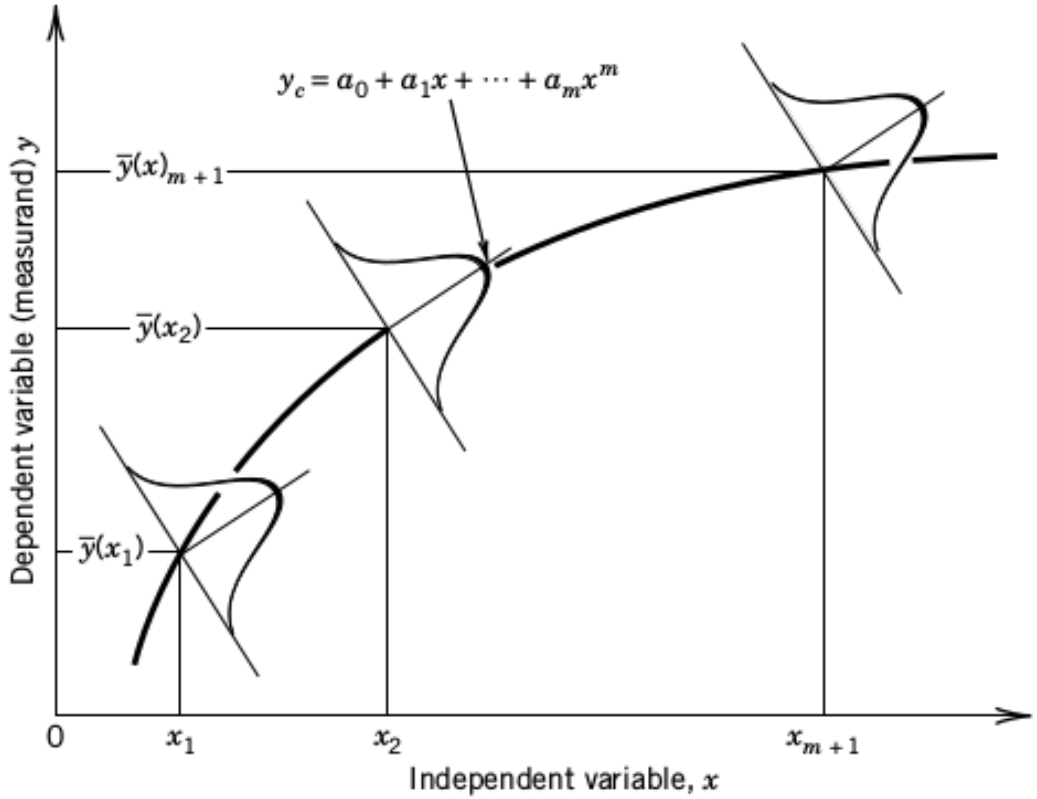

Figure 4.9 Distribution of measured value y about each fixed value of independent variable x. The curve y_c represents a possible functional relationship.

Image: Theory and Design of Mechanical Measurements, 5th Edition

Using Software Packages

- We are trying to find a _____for the data.

  $y_c(x) =$

- This is done by _____the quantity below.

  $D = \Sigma_{i=1}^{N}(y_i - y_{ci})^2 = \Sigma_{i=1}^{N}(y_i - a_0 + a_1 x + a_2 x^2 + \cdots + a_m x^m)^2$

- For a _____curve the coefficients become:

  $a_0 =$, $a_1 =$

Using Software Packages

Most spreadsheet and engineering software packages can perform a _____on a data set. Examples will be shown throughout the course in MATLAB and EXCEL.

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Sample Calibration Data

Sample #	Known Distance $x_i(m)$	Measured Voltage $y_i(V)$
1		
2		
3		
4		
5		

Linear Least Squares Regression Coefficients:

$a_0 =$, $a_1 =$

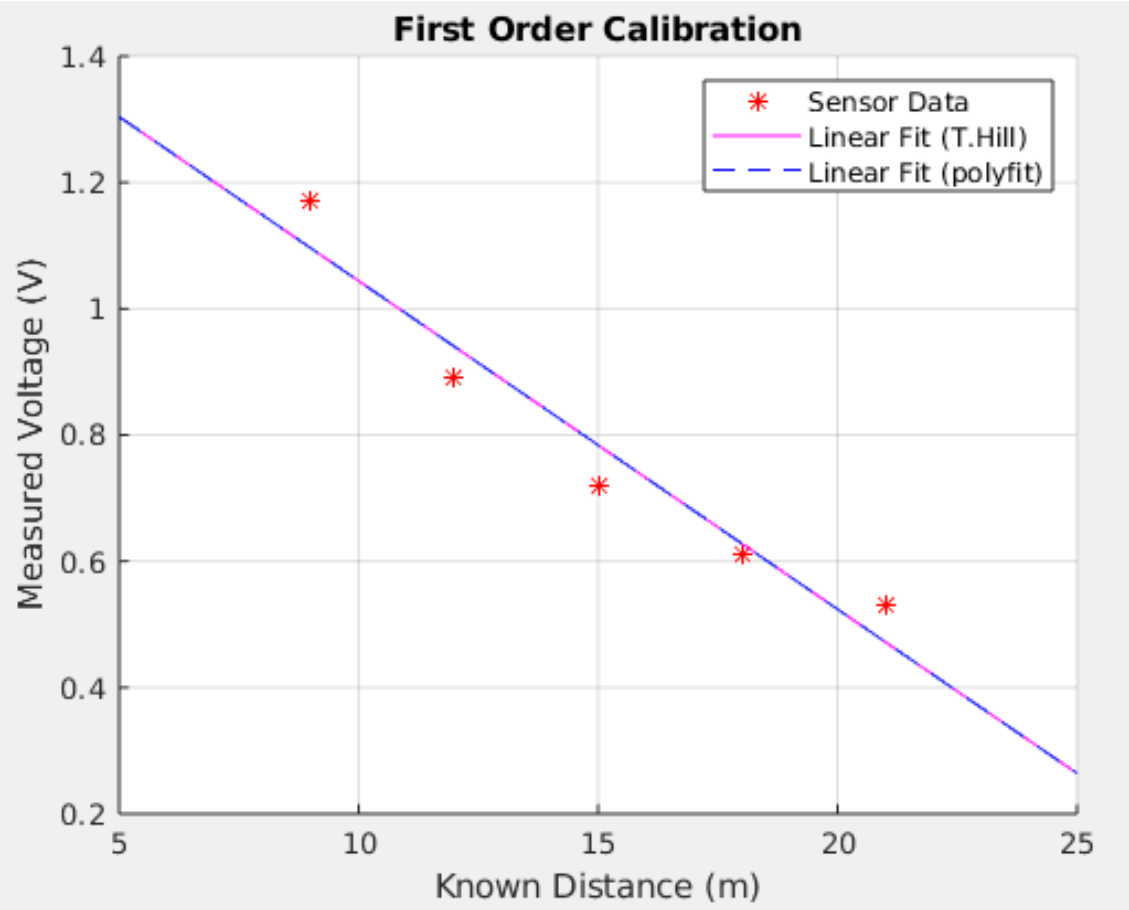
Functional Relationship:

$y =$

Linear Regression in MATLAB - Manual

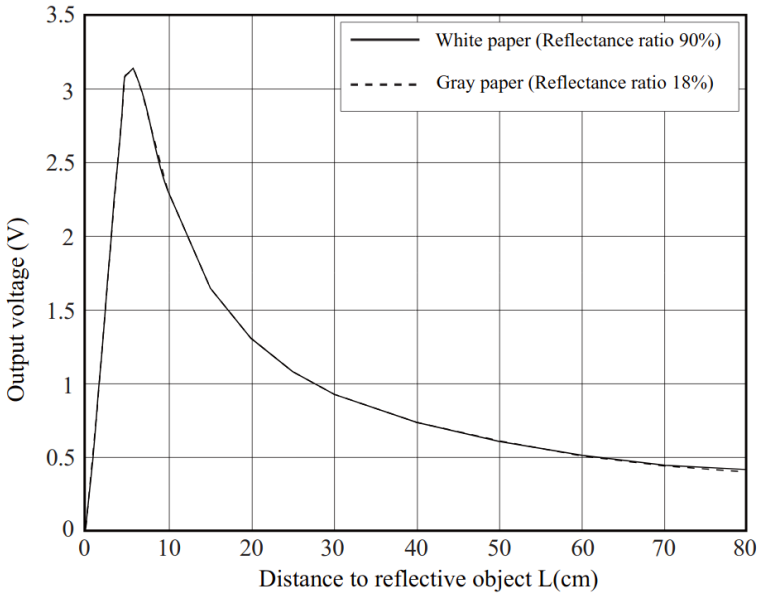
Linear Regression in MATLAB - Manual

First Order Calibration Curve



Images: T.Hill

Fourth Order Calibration Curve



Images: T.Hill, Sharp